Final

WEST BRANCH SCHUYLKILL RIVER WATERSHED TMDL
Schuylkill County

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

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West Branch Schuylkill River Watershed
Schuylkill County, Pennsylvania

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 03-A West Branch Schuylkill River								
Year	**Miles**	**Segment ID Assessment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	9	0446	02329	West Branch Schuylkill River	CWF	305(b) Report	Resource Extraction	metals
1998	9.02	0446	02329	West Branch Schuylkill River	CWF	SWMP	AMD	metals
2002	12.9	20000718-0800-CJD	02329	West Branch Schuylkill River	CWF	SWAP	AMD	siltation

Cold Water Fishes=CWF
Surface Water Monitoring Program = SWMP
Surface Water Assessment Program = SWAP
Abandoned Mine Drainage = AMD
See Attachment D, *Excerpts Justifying Changes Between the 1996, 1998 and 2002 Section 303(d) Lists.*
The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

Introduction

This Total Maximum Daily Load (TMDL) calculation has been prepared for segments in the West Branch Schuylkill River Watershed (Attachment A). It was done to address the impairments noted on the 1996 Pennsylvania 303(d) list, required under the Clean Water Act, and covers one segment on this list (shown in Table 1). High levels of metals, and in some areas depressed pH, caused these impairments. All impairments resulted from acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum) and pH.

Directions to the West Branch Schuylkill River Watershed

The West Branch Schuylkill River watershed is approximately 21 square miles in area. The watershed is located in central Schuylkill County, Pennsylvania and encompasses many communities that include: Minersville, Pottsville, and Cressona. The West Branch Schuylkill River flows east-southeast from its headwaters in the small communities of Glen Dower and Buck Run to its confluence with the Schuylkill River in Schuylkill Haven. The headwater of the West Branch Schuylkill River is assessable from Interstate 81 to S.R. 901 towards Minersville.

[1] Pennsylvania's 1996, 1998 and 2002 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). The 1996 Section 303(d) list provides the basis for measuring progress under the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Segments addressed in this TMDL

The West Branch Schuylkill River is affected by pollution from AMD. This pollution has caused high levels of metals in West Branch Schuylkill River. Major sources of AMD occur at two (2) abandoned deep mine discharges named the Oak Hill/Pine Knot Tunnel, and the Oak Hill Boreholes.

There are active mining operations in the watershed that are considered remining permits. The two (2) major discharges in the watershed are all caused by abandoned mines and are treated as non point sources. There are two NPDES permitted discharges in this watershed. There is a point source (RS&W Coal Co.) that will require a waste load allocation (WLA) that affects the mouth point of the West Branch Schuylkill River. The other (Direnzo Coal Co.) is a pre-existing discharge that will not require a WLA. The pre-existing loads are part of the watershed's LA. If loads are increased, the permittee is required to treat discharge back to pre-existing loads. Each segment on the Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Attachment C for TMDL calculations.

Clean Water Act Requirements

Section 303(d) of the 1972 Clean Water Act requires states, territories, and authorized tribes to establish water quality standards. The water quality standards identify the uses for each waterbody and the scientific criteria needed to support that use. Uses can include designations for drinking water supply, contact recreation (swimming), and aquatic life support. Minimum goals set by the Clean Water Act require that all waters be "fishable" and "swimmable."

Additionally, the federal Clean Water Act and the U.S. Environmental Protection Agency's (EPA) implementing regulations (40 CFR Part 130) require:

- States to develop lists of impaired waters for which current pollution controls are not stringent enough to meet water quality standards (the list is used to determine which streams need TMDLs);

- States to establish priority rankings for waters on the lists based on severity of pollution and the designated use of the waterbody; states must also identify those waters for which TMDLs will be developed and a schedule for development;

- States to submit the list of waters to EPA every two years (April 1 of the even numbered years);

- States to develop TMDLs, specifying a pollutant budget that meets state water quality standards and allocate pollutant loads among pollution sources in a watershed, e.g., point and non-point sources; and

- EPA to approve or disapprove state lists and TMDLs within 30 days of final submission.

Despite these requirements, states, territories, authorized tribes, and EPA have not developed many TMDLs. Beginning in 1986, organizations in many states filed lawsuits against the EPA for failing to meet the TMDL requirements contained in the federal Clean Water Act and its implementing regulations. While EPA has entered into consent agreements with the plaintiffs in several states, many lawsuits still are pending across the country.

In the cases that have been settled to date, the consent agreements require EPA to backstop TMDL development, track TMDL development, review state monitoring programs, and fund studies on issues of concern (e.g., AMD, implementation of non-point source Best Management Practices (BMPs), etc.).

These TMDLs were developed in partial fulfillment of the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA*.

Section 303(d) Listing Process

Prior to developing TMDLs for specific waterbodies, there must be sufficient data available to assess which streams are impaired and should be on the Section 303(d) list. With guidance from the EPA, the states have developed methods for assessing the waters within their respective jurisdictions.

The primary method adopted by the Pennsylvania Department of Environmental Protection (DEP) for evaluating waters changed between the publication of the 1996 and 1998 Section 303(d) lists. Prior to 1998, data used to list streams were in a variety of formats, collected under differing protocols. Information also was gathered through the Section 305(b)[2] reporting process. DEP is now using the Statewide Surface Waters Assessment Protocol (SSWAP), a modification of the EPA's 1989 Rapid Bioassessment Protocol II (RBP-II), as the primary mechanism to assess Pennsylvania's waters. The SSWAP provides a more consistent approach to assessing Pennsylvania's streams.

The assessment method requires selecting representative stream segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment; the length of the stream segment can vary between sites. All the biological surveys included kick-screen sampling of benthic macroinvertebrates, habitat surveys, and measurements of pH, temperature, conductivity, dissolved oxygen, and alkalinity. Benthic macroinvertebrates are identified to the family level in the field.

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on the performance of the segment using a series of biological metrics. If the stream is determined to be impaired, the source and cause of the impairment is documented. An impaired stream must be listed on the state's Section 303(d) list with the source and cause. A TMDL must be developed for the stream segment and each pollutant. In order for the process to

[2] Section 305(b) of the Clean Water Act requires a biannual description of the water quality of the waters of the state.

be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

Although all watersheds must be handled on a case-by-case basis when developing TMDLs, there are basic processes or steps that apply to all cases. They include:

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);
2. Calculating TMDL for the waterbody using EPA approved methods and computer models;
3. Allocating pollutant loads to various sources;
4. Determining critical and seasonal conditions;
5. Public review and comment period on draft TMDL;
6. Submittal of final TMDL to EPA.
7. EPA approval of the TMDL.

Watershed History

The West Branch Schuylkill River lies within the Southern Anthracite Coal Field, which is part of Anthracite Upland Section of the Ridge and Valley Province. The headwaters are within the Heckscherville Valley, which has been extensively mined since the early 1800's. Historic mining includes abandoned surface pits, deep mine openings, spoil piles, and refuse piles, which were affected and abandoned prior to State and Federal laws and regulations requiring reclamation of surface mines. The extensive mining has altered portions of the original streambed throughout the Heckscherville Valley.

Underground or deep mining accounted for the majority of coal extracted from the early 1800's to 1972. Much of the deep mining extended below the water table, which created openings that were susceptible to flooding after abandonment of the mine workings. The Heckscherville Valley was extensively deep mined. The deep mines were separate operations called collieries. Barriers of unmined coal separated the collieries. However, over the years these barrier pillars have been mined through or breeched causing the connection of the mine pools. Ultimately, the Oak Hill/Pine Knot Tunnel collectively drains all these mine pools.

The Oak Hill/Pine Knot Tunnel discharges AMD directly into the West Branch Schuylkill River. It is the largest single source of AMD in the entire Upper Schuylkill River Watershed. The Oak Hill Boreholes are another source of AMD that also discharges directly to the West Branch Schuylkill River. The boreholes are an overflow point for several connected mine pools outside the Heckscherville Valley. Other sources of AMD exist; but none exist south of Pottsville.

Raw sewage "gray water" is a problem, especially in the headwaters. Sewage treatment facilities are operated in Minersville and Pottsville.

Active mining is occurring within the watershed. All the active mining sites are remining permits, since they are mining and reclaiming previously mined areas.

Table 2. Active Mining Permits in West Branch Schuylkill River Watershed

Permit No.	*Operation and Company Name*	*Operation Status*
54773006	Buck Run Mine Reading Anthracite Co.	Active open pit mine. No NPDES permitted discharges.
54773223	Pine Hill Refuse Bank, CLS Coal Co.	Active for reclamation purposes only.
54783702	New St. Nicholas Breaker Reading Anthracite Co.	Active preparation plant and refuse reprocessing (bank removal). NPDES permitted discharges for E & S controls.
54851332	Woods Drift Mine RS&W Coal Co.	Active underground mine. NPDES permitted discharges for treatment of mine water.
54860107	Oak Hill Bank, Reading Anthracite Co.	Active bank removal operation. No NPDES permitted discharges.
54860110	Rhoersville Basin Reading Anthracite Co.	Active bank removal operation. No NPDES permitted discharges.
54860205	Marlin Breaker, Cass Contracting Co.	Active bank removal and preparation plant (breaker). No NPDES permitted discharges.
54871303	7 Foot Drift Mine, D & D Coal Co.	Active underground mine.
54890202	Glenworth Bank, Ginther Coal Co.	Site is at Stage III (final) reclamation.
54920202	Sub G Mine, Direnzo Coal Co.	Active bank removal. NPDES permit and Subchapter G permit for a pre-existing pollutional discharge.
54931302	Little Buck Slope Mine, Mine Hill Coal Co. 50	Underground site being reclaimed.
54940202	Direnzo Breaker, Direnzo Coal Co.	Active preparation plant and refuse reprocessing (bank removal). No NPDES permitted discharges.
54921305	Ridge Slope Mine, Three Way Coal Co.	Bond in forfeiture
54871304	Orchard Mine, Mountain Run Enterprises	Site is in Stage II reclamation.
54851305	Buck Mountain Drift Mine, D & F Deep Mine Coal Co.	Active underground mine.
54840105	Mine Hill 7 Mine, Mine Hill Coal Co.	Active surface mine.

54900204	Valley Peat Mine, Valley Peat Humus Co., Inc.	Site is in Stage II reclamation.

AMD Methodology

A two-step approach is used for the TMDL analysis of impaired stream segments. The first step uses a statistical method for determining the allowable instream concentration at the point of interest necessary to meet water quality standards. This is done at each point of interest (sample point) in the watershed. The second step is a mass balance of the loads as they pass through the watershed. Loads at these points will be computed based on average annual flow.

The statistical analysis described below can be applied to situations where all of the pollutant loading is from non-point sources as well as those where there are both point and non-point sources. The following defines what are considered point sources and non-point sources for the purposes of our evaluation; point sources are defined as permitted discharges, non-point sources are then any pollution sources that are not point sources. For situations where all of the impact is due to non-point sources, the equations shown below are applied using data for a point in the stream. The load allocation made at that point will be for all of the watershed area that is above that point. For situations where there are point-source impacts alone, or in combination with non-point sources, the evaluation will use the point-source data and perform a mass balance with the receiving water to determine the impact of the point source.

Allowable loads are determined for each point of interest using Monte Carlo simulation. Monte Carlo simulation is an analytical method meant to imitate real-life systems, especially when other analyses are too mathematically complex or too difficult to reproduce. Monte Carlo simulation calculates multiple scenarios of a model by repeatedly sampling values from the probability distribution of the uncertain variables and using those values to populate a larger data set. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk[3] by performing 5,000 iterations to determine the required percent reduction so that the water quality criteria, as defined in the *Pennsylvania Code. Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standards,* will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

PR = maximum {0, (1-Cc/Cd)} where (1)

PR = required percent reduction for the current iteration

Cc = criterion in mg/l

[3] @Risk – Risk Analysis and Simulation Add-in for Microsoft Excel, Palisade Corporation, Newfield, NY, 1990-1997.

Cd = randomly generated pollutant source concentration in mg/l based on the observed data

Cd = RiskLognorm (Mean, Standard Deviation) where (1a)

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

The overall percent reduction required is the 99th percentile value of the probability distribution generated by the 5,000 iterations, so that the allowable long-term average (LTA) concentration is:

LTA = Mean * (1 – PR99) where (2)

LTA = allowable LTA source concentration in mg/l

Once the allowable concentration and load for each pollutant is determined, mass-balance accounting is performed starting at the top of the watershed and working down in sequence. This mass-balance or load tracking is explained below.

Load tracking through the watershed utilizes the change in measured loads from sample location to sample location, as well as the allowable load that was determined at each point using the @Risk program.

There are two basic rules that are applied in load tracking; rule one is that if the sum of the measured loads that directly affect the downstream sample point is less than the measured load at the downstream sample point it is indicative that there is an increase in load between the points being evaluated, and this amount (the difference between the sum of the upstream and downstream loads) shall be added to the allowable load(s) coming from the upstream points to give a total load that is coming into the downstream point from all sources. The second rule is that if the sum of the measured loads from the upstream points is greater than the measured load at the downstream point this is indicative that there is a loss of instream load between the evaluation points, and the ratio of the decrease shall be applied to the load that is being tracked (allowable load(s)) from the upstream point.

Tracking loads through the watershed gives the best picture of how the pollutants are affecting the watershed based on the information that is available. The analysis is done to insure that water quality standards will be met at all points in the stream. The TMDL must be designed to meet standards at all points in the stream, and in completing the analysis, reductions that must be made to upstream points are considered to be accomplished when evaluating points that are lower in the watershed. Another key point is that the loads are being computed based on average annual flow and should not be taken out of the context for which they are intended, which is to depict how the pollutants affect the watershed and where the sources and sinks are located spatially in the watershed.

In Low pH TMDLs, acidity is compared to alkalinity as described in Attachment B. Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. Net alkalinity is alkalinity minus acidity, both in units of milligrams per liter (mg/l) $CaCO_3$. Statistical procedures are applied, using the average value for total alkalinity at that point as the target to specify a reduction in the acid concentration. By maintaining a net alkaline stream, the pH value will be in the range between six and eight. This method negates the need to specifically compute the pH value, which for streams affected by low pH may not represent a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

Information for the TMDL analysis performed using the methodology described above is contained in the "TMDLs by Segment" section of this report.

TMDL Endpoints

One of the major components of a TMDL is the establishment of an instream numeric endpoint, which is used to evaluate the attainment of applicable water quality. An instream numeric endpoint, therefore, represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. The endpoint allows for comparison between observed instream conditions and conditions that are expected to restore designated uses. The endpoint is based on either the narrative or numeric criteria available in water quality standards.

Because all of the pollution sources in the watershed are nonpoint sources, the TMDL is expressed as Load Allocations (LAs). All allocations will be specified as long-term average daily concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time as required in PA Title 25 Chapter 96.3(c). The following table shows the applicable water-quality criteria for the selected parameters.

Table 3. Applicable Water Quality Criteria

Parameter	***Criterion Value (mg/l)***	***Total Recoverable/Dissolved***
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50	30-day average; Total
Manganese (Mn)	1.00	Total Recoverable
pH *	6.0-9.0	N/A

*The pH values shown will be used when applicable. In the case of freestone streams with little or no buffering capacity, the TMDL endpoint for pH will be the natural background water quality. These values are typically as low as 5.4 (Pennsylvania Fish and Boat Commission).

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

A TMDL equation consists of a wasteload allocation, load allocation and a margin of safety. The wasteload allocation is the portion of the load assigned to point sources. The load allocation is the portion of the load assigned to non-point sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load). The TMDL allocations in this report are based on available data. Other allocation schemes could also meet the TMDL. Table 5 contains the TMDL component summary for each point evaluated in the watershed. Refer to the maps in Attachment A.

TMDL Allocations Summary

Analyses of data for metals at West Branch Schuylkill River sample points indicated that there was no single critical flow condition for pollutant sources, and further, that there was no significant correlation between source flows and pollutant concentrations (Table 4).

Analysis of monitoring points in this TMDL did not have enough paired flow/parameter data to calculate correlations.

Table 4. Correlation Between Metals and Flow for Selected Points

Point Identification	*Flow vs.*			*Number of Samples*
	Iron	*Manganese*	*Aluminum*	
WB1	**0.589857**	**0.310187**	**0.500511**	**19**

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. The reduction schemes in Table 5 for each segment are based on the assumption that all upstream allocations are achieved and also take into account all upstream reductions. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. As changes occur in the watershed, the TMDLs may be re-evaluated to reflect current conditions. An implicit margin of safety (MOS) based on conservative assumptions in the analysis is included in the TMDL calculations.

The allowable LTA concentration in each segment is calculated using Monte Carlo Simulation as described previously. The allowable load is then determined by multiplying the allowable concentration by the flow and a conversion factor at each sample point. The allowable load is the TMDL and each TMDL includes upstream loads.

Each permitted discharge in a segment is assigned a waste load allocation and the total waste load allocation for each segment is included in this table. There is currently one permitted discharge in the West Branch Schuylkill River watershed. The difference between the TMDL and the WLA is the load allocation (LA) at the point. The LA at each point includes all loads entering the segment, including those from upstream allocation points. The percent reduction is calculated to show the amount of load that needs to be reduced to the area upstream of the point in order for water quality standards to be met at the point.

In some instances, instream processes, such as settling, are taking place within a stream segment. These processes are evidenced by a decrease in measured loading between consecutive sample points. It is appropriate to account for these losses when tracking upstream loading through a segment. The calculated upstream load lost within a segment is proportional to the difference in the measured loading between the sampling points**.**

Table 5. West Branch Schuylkill River Watershed Summary Table

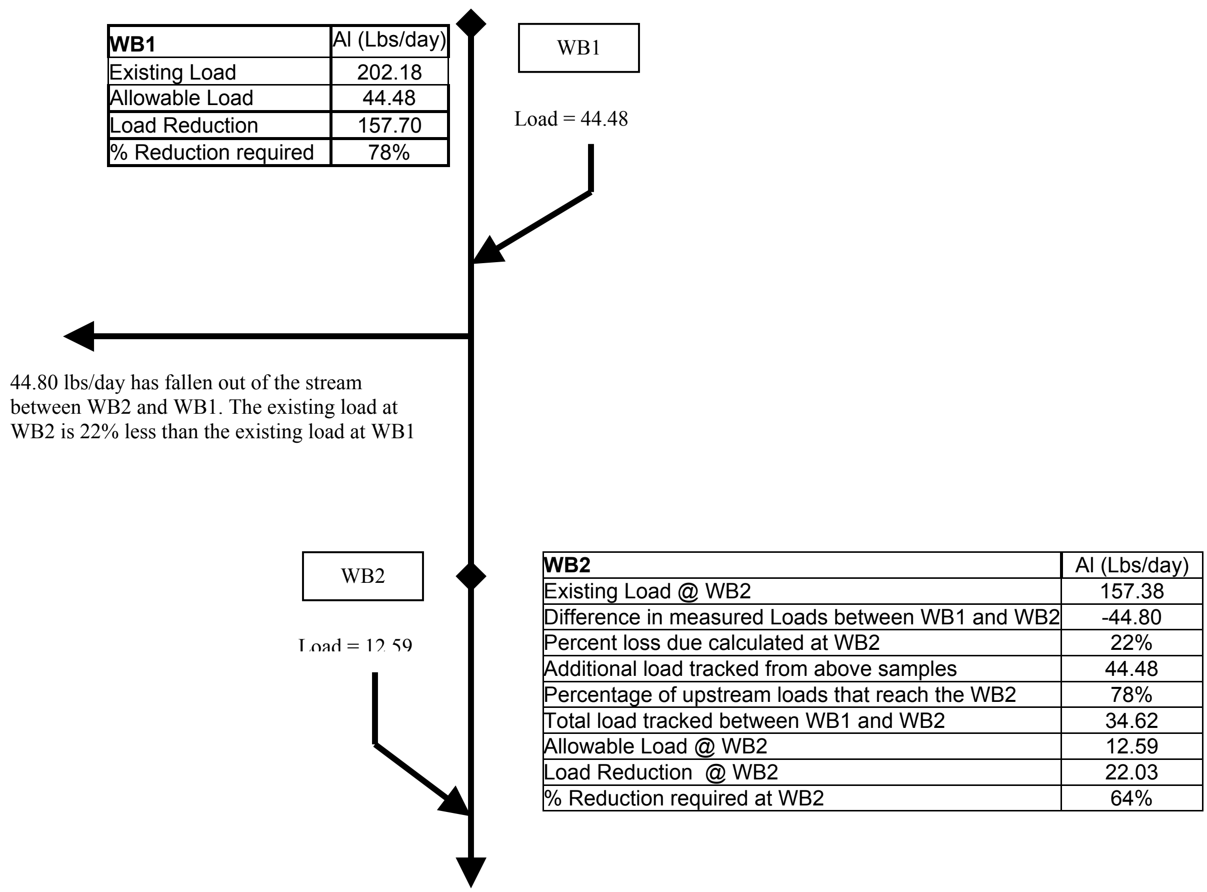
Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
WB1						
Aluminum (lbs/day)	202.18	44.5	0	44.5	157.7	78%
Iron (lbs/day)	976.33	117.2	0	117.2	859.17	88%
Manganese(lbs/day)	551.88	82.8	0	82.8	469.1	85%
Acidity (lbs/day)	1321.9	740.3	0	740.3	581.64	44%
WB2						
Aluminum (lbs/day)	157.38	12.6	0	12.6	22.03	64%
Iron (lbs/day)	26.37	19.3	0	19.3	0	0%*
Manganese(lbs/day)	222.75	13.4	0	13.4	20.04	60%
Acidity (lbs/day)	3812.22	381.2	0	381.2	2849.36	88%
WB3						
Aluminum (lbs/day)	333.89	136.9	0	136.9	52.21	28%
Iron (lbs/day)	1650.49	214.6	0	214.6	1428.81	87%
Manganese(lbs/day)	872.25	139.6	0	139.6	523.31	79%
Acidity (lbs/day)	4404.86	2070.3	0	2070.3	0	0%*
WB4						
Aluminum (lbs/day)	378.68	143.9	0	143.9	37.78	21%
Iron (lbs/day)	1651.65	379.9	0	379.9	0	0%*
Manganese(lbs/day)	905.44	172.0	0	172.0	0.72	0.40%
Acidity (lbs/day)	1347.01	1347.0	0	1347.0	0	0%
WB5						
Aluminum (lbs/day)	13.31	10.8	0	10.8	2.53	19%
Iron (lbs/day)	127.47	48.4	0	48.4	79.03	62%
Manganese(lbs/day)	85.86	68.7	0	68.7	17.17	20%
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
WB6						
Aluminum (lbs/day)	637.23	235.8	2.4	233.4	164.15	41%
Iron (lbs/day)	1592.63	366.3	3.6	362.7	17.12	4%
Manganese(lbs/day)	1029.3	442.6	2.4	440.2	0	0%*
Acidity (lbs/day)	ND	NA	0	NA	NA	NA

NA = not applicable ND = not determined * Total of loads affecting this segment is less than the allowable load calculated at this point, therefore no reduction is necessary.

A Waste Load Allocation was assigned to the permitted mine drainage discharge contained in the West Branch Schuylkill River Watershed. The waste load allocation for discharge RWS001 was determined from designed treatment pond flow value (100 gpm) multiplied by the monthly average permit limits for aluminum, iron and manganese. The WLA for this discharge is being evaluated at sample point WB6. No required reductions of permit limits are needed at this time. All necessary reductions are assigned to non-point sources.

Table 6. Waste Load Allocation at Discharge RWS001			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Discharge RWS001			
Al	2	0.1440	2.40
Fe	3	0.1440	3.60
Mn	2	0.1440	2.40

Following is an example of how the allocations, presented in Table 5, for a stream segment are calculated. For this example, aluminum allocations for WB2 of West Branch Schuylkill River are shown. As demonstrated in the example, all upstream contributing loads are accounted for at each point. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. These analyses follow the example. Attachment A contains maps of the sampling point locations for reference.



WB1	Al (Lbs/day)
Existing Load	202.18
Allowable Load	44.48
Load Reduction	157.70
% Reduction required	78%

WB2	Al (Lbs/day)
Existing Load @ WB2	157.38
Difference in measured Loads between WB1 and WB2	-44.80
Percent loss due calculated at WB2	22%
Additional load tracked from above samples	44.48
Percentage of upstream loads that reach the WB2	78%
Total load tracked between WB1 and WB2	34.62
Allowable Load @ WB2	12.59
Load Reduction @ WB2	22.03
% Reduction required at WB2	64%

The allowable load tracked from WB1 was 44.48 lbs/day. The existing load at WB1 was subtracted from the existing load at WB2 to show the actual measured decrease of aluminum load that has fallen out of the stream between these two sample points (44.80 lbs/day). The percentage of upstream load that actually reaches the stream at point WB2 is then multiplied to the total upstream load that has been tracked to give a total load of aluminum between WB1 and WB2. Since there is a calculated loss of 22%, the allowable load from WB1 (44.48lbs/day) was multiplied by the percentage of upstream load that reaches WB2 (78%). This gives the total load tracked (34.62 lbs/day) that was then subtracted from the calculated allowable load at WB2 to determine the amount of reduction needed at WB2. The allowable load at WB2 was calculated to be 12.59 lbs/day, calling for a 64% reduction, or 22.03 lbs, removed from the total load tracked value of 34.62 lbs/day. From this point, this allowable load of 12.59 lbs/day at WB2 will be tracked to the next downstream point, WB3.

Recommendations

Two primary programs provide maintenance and improvement of water quality in the watershed. DEP's efforts to reclaim abandoned mine lands, coupled with its duties and responsibilities for issuing NPDES permits, will be the focal points in water quality improvement.

Additional opportunities for water quality improvement are both ongoing and anticipated. Historically, a great deal of research into mine drainage has been conducted by BAMR, which administers and oversees the Abandoned Mine Reclamation Program in Pennsylvania, the United States Office of Surface Mining, the National Mine Land Reclamation Center, the National Environmental Training Laboratory, and many other agencies and individuals. Funding from EPA's 319 Grant program, and Pennsylvania's Growing Greener program have been used extensively to remedy mine drainage impacts. These many activities are expected to continue and result in water quality improvement.

The DEP Bureau of Mining and Reclamation administers an environmental regulatory program for all mining activities, mine subsidence regulation, mine subsidence insurance, and coal refuse disposal; conducts a program to ensure safe underground bituminous mining and protect certain structures form subsidence; administers a mining license and permit program; administers a regulatory program for the use, storage, and handling of explosives; provides for training, examination, and certification of applicants for blaster's licenses; and administers a loan program for bonding anthracite underground mines and for mine subsidence and administers the EPA Watershed Assessment Grant Program, the Small Operator's Assistance Program (SOAP), and the Remining Operators Assistance Program (ROAP).

Mine reclamation and well plugging refers to the process of cleaning up environmental pollutants and safety hazards associated with a site and returning the land to a productive condition, similar to DEP's Brownfields program. Since the 1960's, Pennsylvania has been a national leader in establishing laws and regulations to ensure reclamation and plugging occur after active operation is completed.

Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphaned wells. Realizing this task is no small order, DEP has developed concepts to make abandoned mine reclamation easier. These concepts, collectively called Reclaim PA, include legislative, policy land management initiatives designed to enhance mine operator, volunteer land DEP reclamation efforts. Reclaim PA has the following four objectives.

- To encourage private and public participation in abandoned mine reclamation efforts
- To improve reclamation efficiency through better communication between reclamation partners
- To increase reclamation by reducing remining risks
- To maximize reclamation funding by expanding existing sources and exploring new sources

Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of streams polluted with mine drainage, over 7,000 orphaned and abandoned oil and gas wells, widespread subsidence problems, numerous hazardous mine openings, mine fires, abandoned structures and affected water supplies – representing as much as one third of the total problem nationally.

The Schuylkill Headwaters Association, Inc. (SHA) is a watershed group formed to tackle the huge AMD problems in the headwaters of the Schuylkill River. SHA maintains active membership with monthly work sessions, regular public meetings and implementation of group projects. Specifically, SHA received a Growing Greener Grant to design and construct a passive wetland treatment system along the West Branch Schuylkill River near Minersville. The wetland constructed below the Pine Knot Tunnel and Oak Hill Boreholes was completed in 2002. Recently, SHA has applied for another Growing Greener Grant to remediate sources of surface water to the Pine Knot/Oak Hill Tunnel. Another project was constructed for the Oak Hill Boreholes consisting of constructing a channel lined with rock and limestone before discharging to the West Branch Schuylkill River.

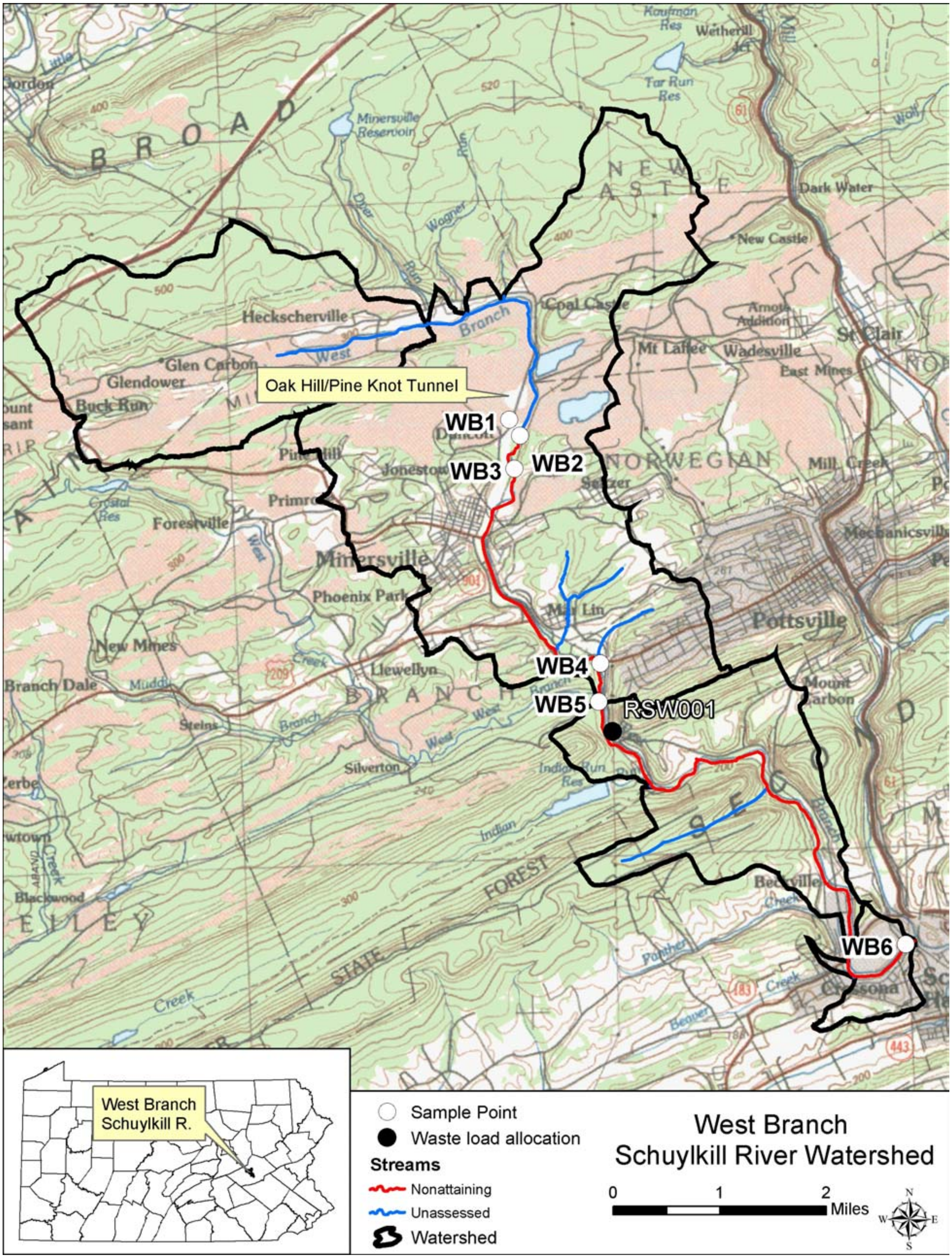
The coal industry, through DEP-promoted remining efforts, can help to eliminate some sources of AMD and conduct some of the remediation identified in the above recommendations through the permitting, mining, and reclamation of abandoned and disturbed mine lands. Special consideration should be given to potential remining projects within these areas, as the environmental benefit versus cost ratio is generally very high.

Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* and the Pottsville Republican to foster public comment on the allowable loads calculated. A public meeting was held on November 16, 2004, at Schuylkill County Agricultural Center in Pottsville, PA, to discuss the proposed TMDL.

Attachment A

West Branch Schuylkill River Watershed Map


Oak Hill/Pine Knot Tunnel
WB1
WB2
WB3
WB4
WB5
RSW001
WB6
West Branch
Schuylkill R.
Sample Point
Waste load allocation
Streams
Nonattaining
Unassessed
Watershed
West Branch
Schuylkill River Watershed
0
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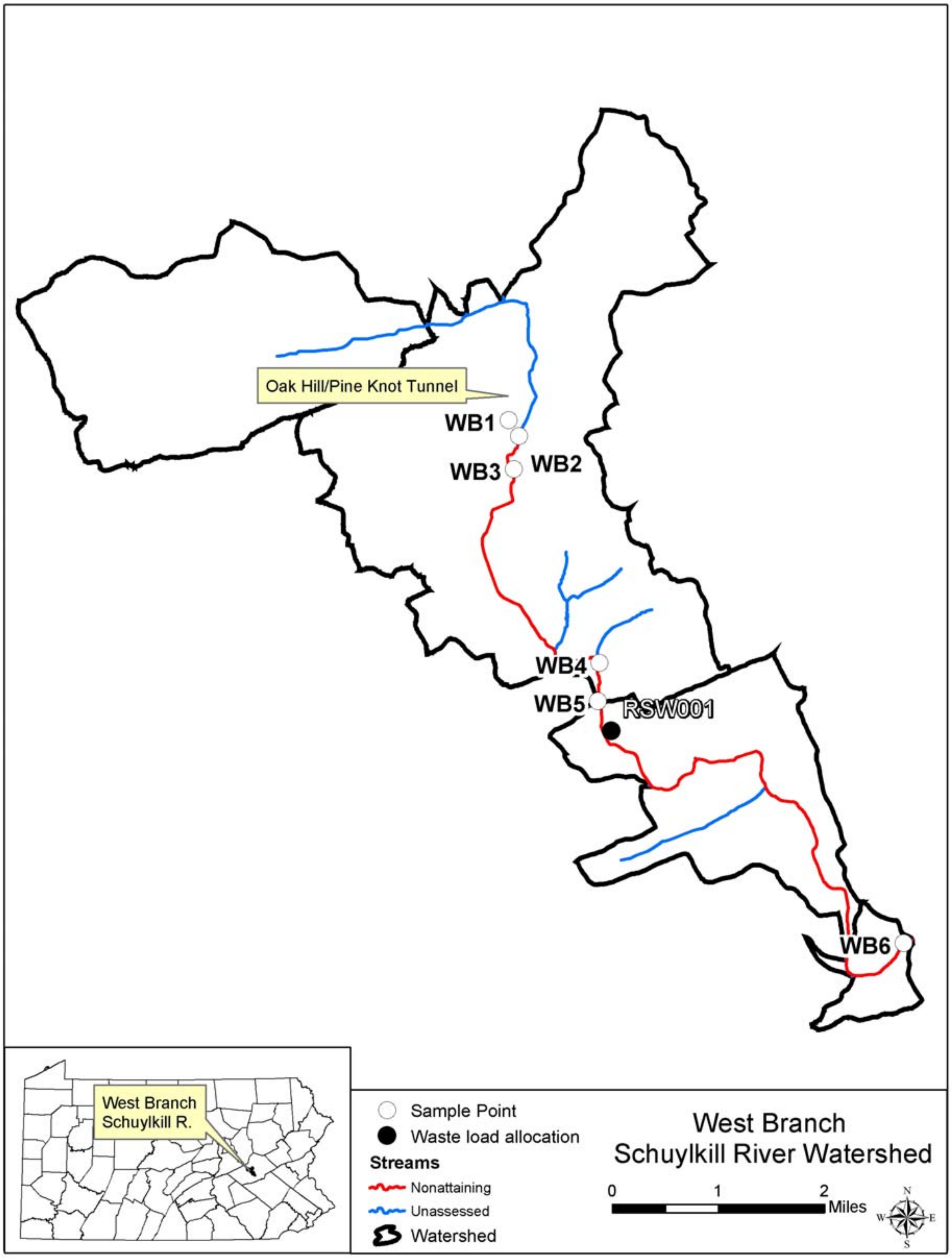
Miles


Oak Hill/Pine Knot Tunnel
WB1
WB2
WB3
WB4
WB5
RSW001
WB6
West Branch
Schuylkill R.
Sample Point
Waste load allocation
Streams
Nonattaining
Unassessed
Watershed
West Branch
Schuylkill River Watershed
0
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Attachment B

Method for Addressing Section 303(d) Listings for pH and *Surface Mining Control and Reclamation Act*

Method for Addressing Section 303(d) Listings for pH

There has been a great deal of research conducted on the relationship between alkalinity, acidity, and pH. Research published by the Pa. Department of Environmental Protection demonstrates that by plotting net alkalinity (alkalinity-acidity) vs. pH for 794 mine sample points, the resulting pH value from a sample possessing a net alkalinity of zero is approximately equal to six (Figure 1). Where net alkalinity is positive (greater than or equal to zero), the pH range is most commonly six to eight, which is within the EPA's acceptable range of six to nine and meets Pennsylvania water quality criteria in Chapter 93.

The pH, a measurement of hydrogen ion acidity presented as a negative logarithm, is not conducive to standard statistics. Additionally, pH does not measure latent acidity. For this reason, and based on the above information, Pennsylvania is using the following approach to address the stream impairments noted on the Section 303(d) list due to pH. The concentration of acidity in a stream is at least partially chemically dependent upon metals. For this reason, it is extremely difficult to predict the exact pH values, which would result from treatment of abandoned mine drainage. Therefore, net alkalinity will be used to evaluate pH in these TMDL calculations. This methodology assures that the standard for pH will be met because net alkalinity is a measure of the reduction of acidity. When acidity in a stream is neutralized or is restored to natural levels, pH will be acceptable. Therefore, the measured instream alkalinity at the point of evaluation in the stream will serve as the goal for reducing total acidity at that point. The methodology that is applied for alkalinity (and therefore pH) is the same as that used for other parameters such as iron, aluminum, and manganese that have numeric water quality criteria.

Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. Net alkalinity is alkalinity minus acidity, both being in units of milligrams per liter (mg/l) $CaCO_3$. The same statistical procedures that have been described for use in the evaluation of the metals is applied, using the average value for total alkalinity at that point as the target to specify a reduction in the acid concentration. By maintaining a net alkaline stream, the pH value will be in the range between six and eight. This method negates the need to specifically compute the pH value, which for mine waters is not a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

There are several documented cases of streams in Pennsylvania having a natural background pH below six. If the natural pH of a stream on the Section 303(d) list can be established from its upper unaffected regions, then the pH standard will be expanded to include this natural range. The acceptable net alkalinity of the stream after treatment/abatement in its polluted segment will be the average net alkalinity established from the stream's upper, pristine reaches added to the acidity of the polluted portion in question. Summarized, if the pH in an unaffected portion of a stream is found to be naturally occurring below six, then the average net alkalinity for that portion (added to the acidity of the polluted portion) of the stream will become the criterion for the polluted portion. This "natural net alkalinity level" will be the criterion to which a 99 percent confidence level will be applied. The pH range will be varied only for streams in which a natural unaffected net alkalinity level can be established. This can only be done for streams that have upper segments that are not impacted by mining activity. All other streams will be required to reduce the acid load so the net alkalinity is greater than zero 99% of time.

Reference: *Rose, Arthur W. and Charles A. Cravotta, III 1998. Geochemistry of Coal Mine Drainage. Chapter 1 in Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania. Pa. Dept. of Environmental Protection, Harrisburg, Pa.*

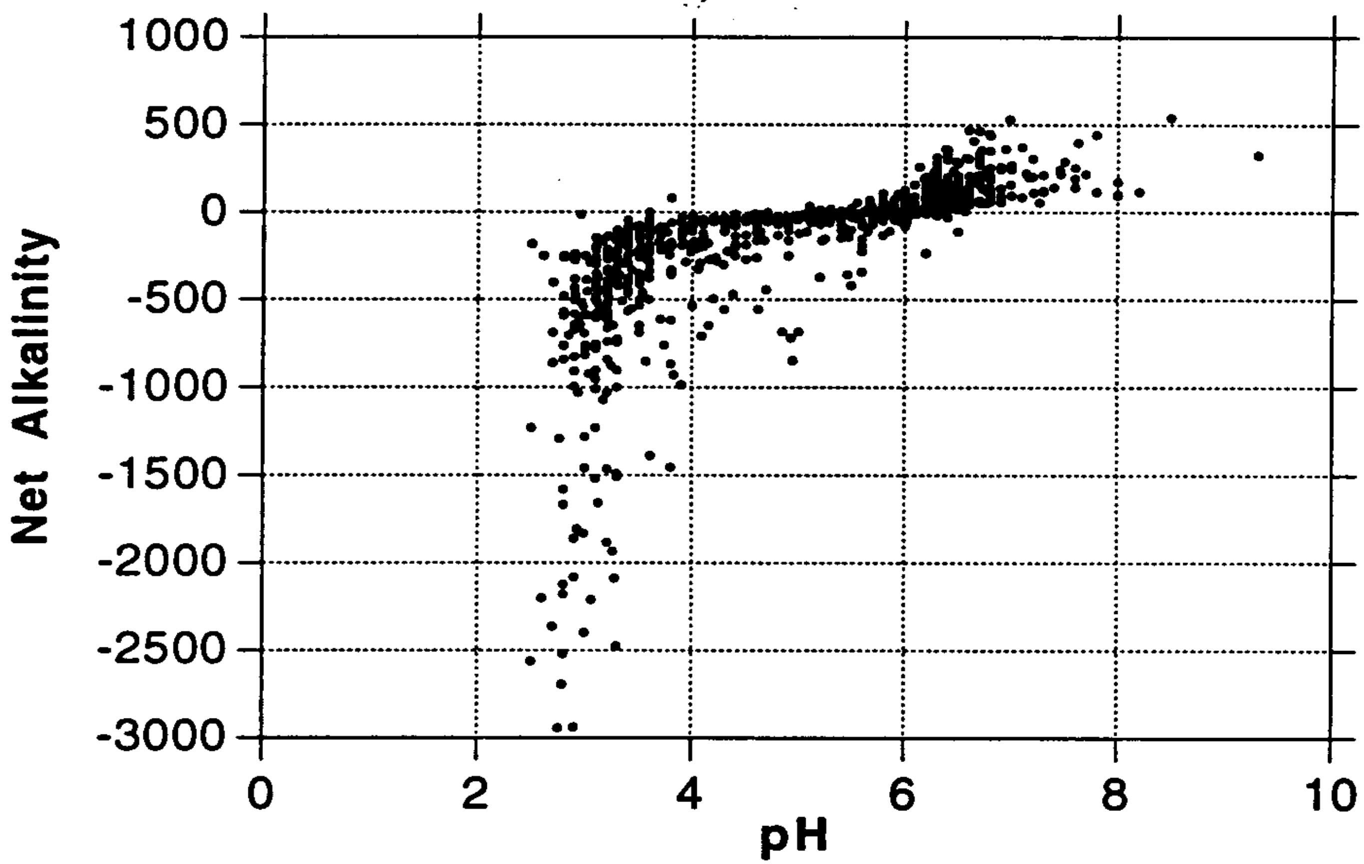


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

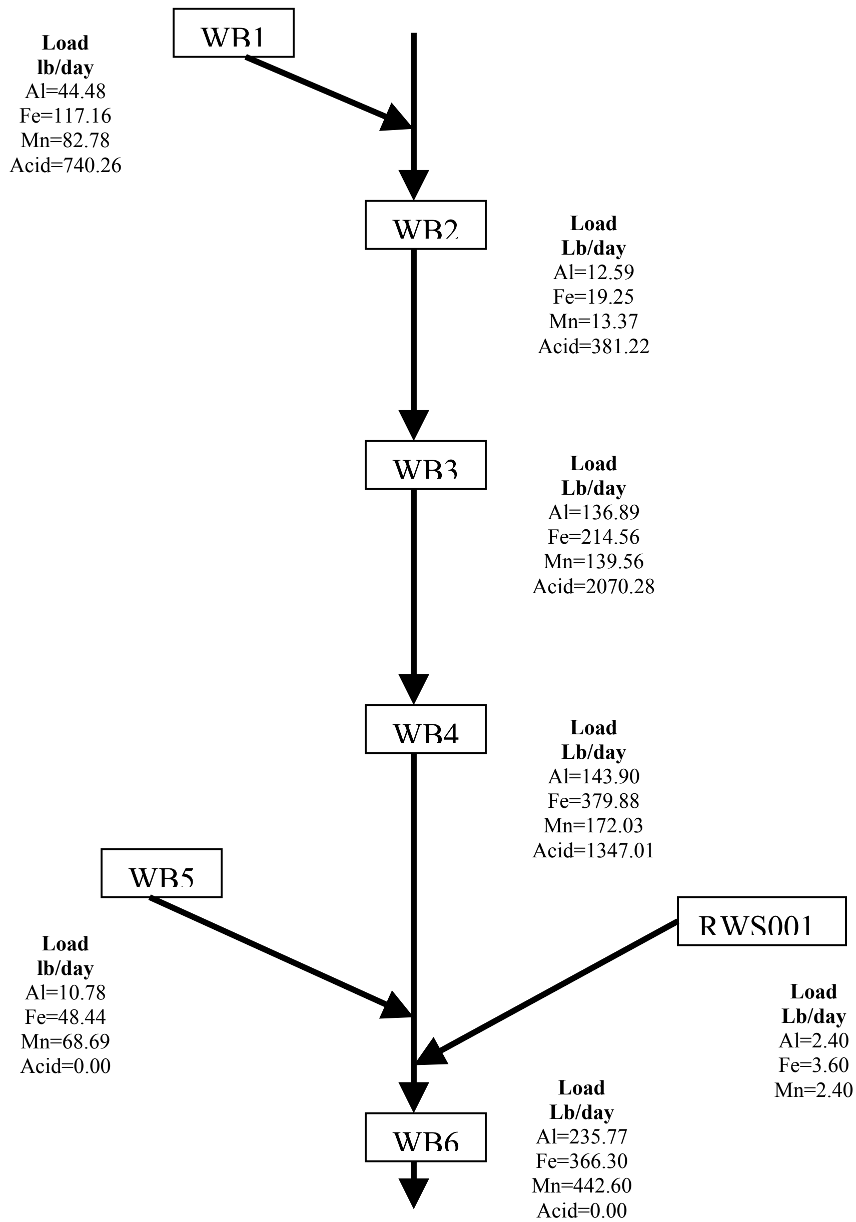
Attachment C
TMDLs By Segment

West Branch Schuylkill River

The TMDL for West Branch Schuylkill River consists of a load allocation to four (4) sampling sites along the main stem of the West Branch Schuylkill River (WB2, WB3, WB4 and WB6), one (1) discharge (WB1), one (1) sampling site along a tributary (WB5) and one waste load allocation (RWS001). Data sets include 8 samples taken on the same days for each sample point WB2 through WB6, except for WB1, which has 19 samples, a majority from previous samplings at that site. All sample points are shown on the maps included in Attachment A as well as on the loading schematic drawn on the following page.

The West Branch Schuylkill River is listed for metals from AMD as being the cause of the degradation to the stream. Although this TMDL will focus primarily on metals analysis to the West Branch Schuylkill River watershed, pH and reduced acid loading will be performed as well. The objective is to reduce acid loading to the stream, which will in turn raise the pH to the desired range and keep a net alkalinity above zero, 99% of the time. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoint section in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at each sample point for metals and acidity. The analysis is designed to produce an average value that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water-quality criteria 99% of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and standard deviation of the data set, 5000 iterations of sampling were completed, and compared against the water-quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water-quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99% of the time. The mean value from this data set represents the long-term average concentration that needs to be met to achieve water-quality standards. Following is an explanation of the TMDL for each allocation point.



TMDL calculations- WB1 – Oak Hill/Pine Knot Tunnel

The TMDL for sample point WB1 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this upstream segment was computed using water-quality sample data collected at point WB1. The average flow, measured at the sampling point WB1 (16.51 MGD), is used for these computations. The discharge, WB1, is below the mouth of the Oak Hill/Pine Knot tunnel but is within a constructed lined channel that is solely fed by the tunnel discharge which enters into the West Branch Schuylkill River, the allowable load allocations calculated at WB1 directly affects the downstream point WB2.

Sample data at point WB1 shows that this discharge of the West Branch Schuylkill has a pH ranging between 5.3 and 6.4. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

TMDLs for aluminum, iron manganese and acidity at WB1 have been calculated. Table C1 shows the measured and allowable concentrations and loads at WB1. Table C2 shows percent reductions for aluminum, iron, manganese and acidity required at this point.

Table C1		Measured		Allowable	
Flow (gpm)=	256.75	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	1.47	202.2	0.32	44.5
	Iron	7.09	976.3	0.85	117.2
	Manganese	4.01	551.9	0.60	82.8
	Acidity	9.60	1321.9	5.38	740.3
	Alkalinity	28.60	3938.2		

Table C2. WB1				
WB1	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ WB1	202.18	976.33	551.88	1321.90
Allowable Load @ WB1	44.48	117.16	82.78	740.26
Load Reduction @ WB1	157.70	859.17	469.10	581.64
% Reduction required @ WB1	78%	88%	85%	44%

TMDL calculations- WB2 – On West Branch Schuylkill River near Duncott

The TMDL for sampling point WB2 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point WB2. The average flow, measured at the sampling point WB2 (12.52 MGD), is used for these computations. The loads calculated at WB2, the first sample point on West Branch Schuylkill River, will directly affect the downstream point WB3.

Sample data at point WB2 shows pH ranging between 4.6 and 6.4; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point WB2 for all parameters were computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from point WB1 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between point WB1 and WB2 to determine a total load tracked for the segment of stream between WB2 and WB1. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at WB2.

Table C3 shows the measured and allowable concentrations and loads at WB2. Table C4 shows the percent reduction needed for aluminum, iron, manganese and acidity at this point.

Table C3		Measured		Allowable	
Flow (gpm)=	8696.75	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	1.51	157.4	0.12	12.6
	Iron	0.25	26.4	0.18	19.3
	Manganese	2.13	222.8	0.13	13.4
	Acidity	36.50	3812.2	3.65	381.2
	Alkalinity	10.40	1086.2		

Table C4. WB2				
WB2	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ WB2	157.38	26.37	222.75	3812.22
Difference in measured Loads between the loads that enter and existing WB2	-44.80	-949.96	-329.13	2490.32
Percent loss due calculated at WB2	22%	97%	60%	NA
Additional load tracked from above samples	44.48	117.16	82.78	740.26
Percentage of upstream loads that reach the WB2	78%	3%	40%	NA
Total load tracked between WB1 and WB2	34.62	3.16	33.41	3230.58
Allowable Load @ WB2	12.59	19.25	13.37	381.22
Load Reduction @ WB2	22.03	-16.09	20.04	2849.36
% Reduction required at WB2	64%	0%	60%	88%

The percent reduction required for iron at WB2 was calculated as 0. The upstream existing load for iron from WB1 was found to be greater than the existing load at sample point WB2. The percent of upstream load that actually reach sample point WB2 was calculated resulting in a value for percent loss of upstream load that occurs before the load reaches this sample point. Therefore this loss is considered in the reductions at WB2. A loss of 949.96 lbs between the upstream point and WB2 results in a 97% loss of iron loading in this segment of stream. The total load tracked for iron was found to be less then the calculated allowable load, resulting in no reduction necessary. Upstream loads were also found to be greater than WB2 loads for aluminum and manganese as well. In this instance, the total loads tracked were greater than the allowable load at WB2; therefore reductions of 64% for aluminum and 60% for manganese were needed.

TMDL calculations- WB3 – West Branch Schuylkill River below the Oakhill boreholes

The TMDL for sampling point WB3 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point WB3. The average flow, measured at the sampling point WB3 (36.36 MGD), is used for these computations. The loads calculated at WB3 will directly affect the downstream point WB4.

Sample data at point WB3 shows pH ranging between 6.2 and 6.7; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point WB3 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from point WB2 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between point WB2 and WB3 to determine a total load tracked for the segment of stream between WB2 and WB3. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at WB3.

Table C5 shows the measured and allowable concentrations and loads at WB3. Table C6 shows the percent reduction required for all parameters.

Table C5		Measured		Allowable	
Flow (gpm)=	25251.50	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	1.10	333.89	0.45	136.89
	Iron	5.44	1650.49	0.71	214.56
	Manganese	2.88	872.25	0.46	139.56
	Acidity	14.53	4404.86	6.83	2070.28
	Alkalinity	39.75	12054.60		

Table C6. WB3				
WB3	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ WB3	333.89	1650.49	872.25	4404.86
Difference in measured load between WB2 and WB3	176.51	1624.12	649.50	592.64
Additional load tracked from WB2	12.59	19.25	13.37	381.22
Total load tracked between WB2 and WB3	189.10	1643.37	662.87	973.86
Allowable Load @ WB3	136.89	214.56	139.56	2070.28
Load Reduction @ WB3	52.21	1428.81	523.31	-1096.42
% Reduction @ WB3	28%	87%	79%	0%

Because the total acidic load tracked to this point was less than the allowable load calculated at WB3, there is no percent reduction needed. Instead, the measured acidic load is 1096.42 lb/day less than the allowed load at this point. Table C6 shows that 28% reduction of aluminum, 87% reduction of iron and 79% reduction of manganese is required at sample point WB3

TMDL calculations- WB4 – West Branch Schuylkill River below confluence of two tributaries

The TMDL for sampling point WB4 on the West Branch Schuylkill River consists of a load allocation of the entire area above point WB4 as shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point WB4. The average flow, measured at the sampling point WB4 (42.79 MGD), is used for these computations. Loads from WB4 will directly affect the downstream sample point WB6.

There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point WB4 shows pH ranging between 6.4 and 6.9; pH will be addressed as part of this TMDL.

The measured and allowable loading for point WB4 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The existing load from point WB3 show the total load that was permitted from upstream sources. This value was subtracted from the existing load at point WB4 to determine a remaining existing load for the segment of stream between WB3 and WB4. This remaining existing load will then be compared to the calculated allowable load to determine if further reductions are needed to meet the calculated TMDL at WB4.

Table C7 shows the measured and allowable concentrations and loads at WB4. Table C8 shows the percent reductions required for aluminum, iron, manganese and acidity at sample point WB4.

Table C7		Measured		Allowable	
Flow (gpm)=	5752.44	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	1.06	378.7	0.40	143.9
	Iron	4.63	1651.7	1.06	379.9
	Manganese	2.54	905.4	0.48	172.0
	Acidity	3.78	1347.0	3.78	1347.0
	Alkalinity	47.90	17091.8		

Table C8 WB4				
WB4	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ WB4	378.68	1651.65	905.44	1347.01
Difference in measured Loads between the loads that enter and existing WB4	44.79	1.16	33.19	-3057.85
Percent loss due calculated at WB4	NA	NA	NA	69%
Additional load tracked from above samples	136.89	214.56	139.56	2070.28
Percentage of upstream loads that reach the WB4	NA	NA	NA	31%
Total load tracked between WB3 and WB4	181.68	215.72	172.75	633.09
Allowable Load @ WB4	143.90	379.88	172.03	1347.01
Load Reduction @ WB4	37.78	-164.16	0.72	-713.92

% Reduction required at WB4	21%	0%	0.4%	0%

The percent reduction for iron and acidity at WB4 was found to be 0. The upstream existing loads for acidity from WB3 were found to be greater than the existing loads at sample point WB4. The percent of upstream loads that actually reach sample point WB4 were calculated resulting in values for percent loss of upstream loads that occur before the loads reach this sample point. Therefore these losses are considered in the reductions at WB4. A loss of 3057.85 lbs of acidity between the upstream points and WB4 results in a 69% loss of load in this segment of stream. The total iron load tracked at WB4 was found to be 164.16 lbs/day less then the allowable load calculated at this point. Therefore no percent reduction for iron is required at WB4. Because the total tracked load for iron was also found to be less than the calculated allowable iron load at WB4, no reduction was necessary.

TMDL calculations- WB5 – Near mouth of West West Branch Schuylkill River

The TMDL for sample point WB5 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this upstream segment was computed using water-quality sample data collected at point WB5. The average flow, measured at the sampling point WB5 (17.99 MGD), is used for these computations. This sample point is on the West West Branch Schuylkill River before it enters into the West Branch Schuylkill River, the allowable load allocations calculated at WB5 is equal to the actual load that directly affects the downstream point WB6.

Sample data at point WB5 shows that this tributary of the West Branch Schuylkill has a pH ranging between 6.6 and 7.4. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

TMDLs for aluminum, iron and manganese at WB5 have been calculated. There was no acidity measured at this point. Because water quality standards are met, a TMDL for this parameter isn't necessary and is not calculated. The existing acidic load values at WB5 in Table C9 will be denoted as "NA".

Table C9 shows the measured and allowable concentrations and loads at WB5. Table C10 shows percent reductions for aluminum, iron and manganese required at this point.

Table C9		Measured		Allowable	
Flow (gpm)=	12491.13	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.09	13.3	0.07	10.8
	Iron	0.85	127.5	0.32	48.4
	Manganese	0.57	85.9	0.46	68.7
	Acidity	ND	NA		
	Alkalinity	33.60	5040.5		

Table C10 WB5			
WB5	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)
Existing Load @ WB5	13.31	127.47	85.86
Allowable Load @ WB5	10.78	48.44	68.69
Load Reduction @ WB5	2.53	79.03	17.17
% Reduction required @ WB5	19%	62%	20%

Waste Load Allocation – Discharge RWS001, R. S. & W. Coal Company

The waste load allocation for discharge RWS001 was determined from designed treatment pond flow value (100 gpm) multiplied by the monthly average permit limits for aluminum, iron and manganese. The waste load allocation will be subtracted from the calculated allowable load at the next downstream point on West Branch Schuylkill River, WB6. The following table shows the waste load allocation for discharge RWS001.

Table C11. Waste Load Allocation at Discharge RWS001			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Discharge RWS001			
Al	2	0.1440	2.40
Fe	3	0.1440	3.60
Mn	2	0.1440	2.40

TMDL calculations- WB6 – Mouth of West Branch Schuylkill River

The TMDL for sampling point WB6 on West Branch Schuylkill River consists of a load allocation of the entire area above point WB6 as shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point WB6. The average flow, measured at the sampling point WB6 (85.20 MGD), is used for these computations.

There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point WB6 shows pH ranging between 6.6 and 7.5; pH will be addressed as part of this TMDL.

The measured and allowable loading for point WB6 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The load from points WB4 and WB5, show the total load that was permitted from upstream sources. This value, was subtracted from the existing load at point WB6 to determine a remaining existing load for the segment of stream between WB4 – WB5 and WB6. This remaining load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at WB6.

TMDLs for aluminum, iron and manganese at WB6 have been calculated. There was no acidity measured at this point. Because water quality standards are met, a TMDL for the acidic parameter isn't necessary and is not calculated. The existing acidic load values at WB6 in Table C12 will be denoted as "NA".

Table C12 shows the measured and allowable concentrations and loads at WB6. Table C13 shows the percent reductions required for aluminum, iron and manganese at sample point WB6.

Table C12		Measured		Allowable	
Flow (gpm)=	59169.13	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.90	637.2	0.33	235.8
	Iron	2.24	1592.6	0.52	366.3
	Manganese	1.45	1029.3	0.62	442.6
	Acidity	ND	NA		
	Alkalinity	17.90	12719.7		

Table C13 WB6			
WB6	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)
Existing Load @ WB6	637.23	1592.63	1029.30
Difference in measured Loads between the loads that enter and existing WB6	245.24	-186.49	38.00
Percent loss due calculated at WB6	NA	10%	NA
Additional load tracked from above samples	154.68	428.32	240.72
Percentage of upstream loads that reach the WB6	NA	90%	NA
Total load tracked between WB4/WB5 and WB6	399.92	383.42	278.72
Allowable Load @ WB6	235.77	366.30	442.60
Load Reduction @ WB6	164.15	17.12	-163.88
% Reduction required at WB6	41%	4%	0%

The percent reduction for manganese at WB6 was found to be 0. The allowable load calculated for manganese was 163.88 lbs/day greater than the total calculated load tracked from upstream sources added to the load found at WB6. Because of this smaller calculated load, no reduction was necessary for manganese. The upstream existing load for iron from WB4, and WB5 was found to be greater than the existing load at sample point WB6. The percent of upstream loads that actually reach sample point WB6 were calculated resulting in values for percent loss of upstream loads that occur before the loads reach this sample point. Therefore this loss is considered in the reductions at WB6. A loss of 186.49 lbs of iron between the upstream points and WB6 results in a 10% loss of load in this segment of stream. Because the actual load tracked is still greater than the calculated allowable iron load, a 4% reduction was still needed at this segment of stream. At sample point WB6, 164.15 lbs of aluminum need to be reduced resulting in a 41% reduction.

Margin of Safety

PADEP used an implicit MOS in these TMDLs derived from the Monte Carlo statistical analysis. The Water Quality standard states that water quality criteria must be met at least 99% of the time. All of the @Risk analyses results surpass the minimum 99% level of protection. Another margin of safety used for this TMDL analysis results from:

- Effluent variability plays a major role in determining the average value that will meet water-quality criteria over the long-term. The value that provides this variability in our analysis is the standard deviation of the dataset. The simulation results are based on this variability and the existing stream conditions (an uncontrolled system). The general assumption can be made that a controlled system (one that is controlling and stabilizing the pollution load) would be less variable than an uncontrolled system. This implicitly builds in a margin of safety.

- A MOS is also the fact that the calculations were performed with a daily Iron average instead of the 30-day average.

Seasonal Variation

Seasonal variation is implicitly accounted for in these TMDLs because the data used represents all seasons.

Critical Conditions

The reductions specified in this TMDL apply at all flow conditions. A critical flow condition could not be identified from the data used for this analysis.

Attachment D

Excerpts Justifying Changes Between the 1996, 1998 and 2002 Section 303(d) Lists

The following are excerpts from the Pennsylvania DEP 303(d) narratives that justify changes in listings between the 1996, 1998, and 2002 lists. The 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

In the 1996 303(d) narrative, strategies were outlined for changes to the listing process. Suggestions included, but were not limited to, a migration to a Global Information System (GIS), improved monitoring and assessment, and greater public input.

The migration to a GIS was implemented prior to the development of the 1998 303(d) list. As a result of additional sampling and the migration to the GIS some of the information appearing on the 1996 list differed from the 1998 list. Most common changes included:

1. mileage differences due to recalculation of segment length by the GIS;
2. slight changes in source(s)/cause(s) due to new EPA codes;
3. changes to source(s)/cause(s), and/or miles due to revised assessments;
4. corrections of misnamed streams or streams placed in inappropriate SWP subbasins; and
5. unnamed tributaries no longer identified as such and placed under the named watershed listing.

Prior to 1998, segment lengths were computed using a map wheel and calculator. The segment lengths listed on the 1998 303(d) list were calculated automatically by the GIS (ArcInfo) using a constant projection and map units (meters) for each watershed. Segment lengths originally calculated by using a map wheel and those calculated by the GIS did not always match closely. This was the case even when physical identifiers (e.g., tributary confluence and road crossings) matching the original segment descriptions were used to define segments on digital quad maps. This occurred to some extent with all segments, but was most noticeable in segments with the greatest potential for human errors using a map wheel for calculating the original segment lengths (e.g., long stream segments or entire basins).

Attachment E

Water Quality Data Used In TMDL Calculations

Date	Coll by	Project MP	FLOW (GPM)	Ph	Temp (C)	AL (UG/L)	ALK (MG/L)	FE (UG/L)	HOT A (MG/L)	MN (UG/L)
7/22/1997	DEP	WB1	5211.00	6.20		1070.00	30.00	6640.00	18.80	3400.00
8/29/1997	DEP	WB1	11271.00	5.80		1800.00	22.00	8230.00	20.00	4450.00
9/30/1997	DEP	WB1	8100.00	6.00		1660.00	30.00	8760.00	22.00	6340.00
12/3/1997	DEP	WB1	7890.00	6.10		1350.00	28.00	8300.00	5.20	3980.00
1/7/1998	DEP	WB1	7199.00	5.90		1440.00	26.00	7410.00	5.60	3970.00
2/5/1998	DEP	WB1	15877.00	5.70		1800.00	26.00	6610.00	22.00	4120.00
3/11/1998	DEP	WB1	23751.00	5.60		2230.00	22.00	5388.00	10.40	3530.00
4/9/1998	DEP	WB1	14948.00	5.80		1530.00	26.00	5440.00	1.60	3280.00
5/14/1998	DEP	WB1	30000.00	5.30		3380.00	15.00	3160.00	10.00	3160.00
6/10/1998	DEP	WB1	10453.00	6.10		1050.00	30.00	5410.00	0.00	3260.00
8/19/1998	DEP	WB1	5595.00	6.20		909.00	34.00	6830.00	0.00	3960.00
10/29/1998	DEP	WB1	4035.00	6.40		1230.00	36.00	10800.00	0.00	5620.00
11/24/1998	DEP	WB1	3308.00	6.30		838.00	38.00	9740.00	0.00	4930.00
12/22/1998	DEP	WB1	2649.00	6.30		810.00	42.00	9880.00	0.00	4810.00
2/25/1999	DEP	WB1	8357.00	6.10		1420.00	26.00	7440.00	0.00	4360.00
3/25/1999	DEP	WB1	9944.00	5.70		2080.00	19.60	6730.00	8.40	3760.00
4/29/1999	DEP	WB1	12000.00	6.00		1210.00	30.00	6100.00	0.00	3650.00
5/20/2003	DEP	WB1	9043.00	6.20	13.00	790.00	36.20	6290.00	29.60	2920.00
6/27/2003	DEP	WB1	28216.00	5.90	15.40	1300.00	26.60	5560.00	28.80	2650.00

average			**11465.63**	**5.98**	**14.20**	**1468.26**	**28.60**	**7090.42**	**9.60**	**4007.89**
st dev			**7962.438**	**0.280038**	**1.6971**	**622.5257**	**6.674662**	**1868.242**	**10.58217**	**927.683**
Date	**Coll by**	**Project MP**	**FLOW (GPM)**	**Ph**	**Temp (C)**	**AL (UG/L)**	**ALK (MG/L)**	**FE (UG/L)**	**HOT A (MG/L)**	**MN (UG/L)**
9/5/2002	DEP	WB2	137.00	4.60		6550.00	9.80	1010.00	86.00	9990.00
10/9/2002	DEP	WB2	292.00	6.40		1710.00	28.00	1010.00	27.60	5350.00
11/5/2002	DEP	WB2	5861.00	5.10		504.00	8.00	ND	36.00	239.00
12/23/2002	DEP	WB2	15440.00	5.00		587.00	6.60	ND	26.80	159.00
3/17/2003	DEP	WB2	21685.00	5.10	9.60	959.00	6.20	ND	29.00	272.00
4/21/2003	DEP	WB2	9005.00	6.00	13.60	564.00	8.20	ND	37.20	461.00
5/20/2003	DEP	WB2	2747.00	5.70	15.70	661.00	8.00	ND	27.80	418.00
6/27/2003	DEP	WB2	14407.00	6.10	19.80	520.00	8.40	ND	21.60	173.00

average			**8696.75**	**5.50**	**14.68**	**1506.88**	**10.40**	**NA**	**36.50**	**2132.75**
st dev			**7875.987**	**0.636957**	**4.2516**	**2077.255**	**7.196825**	**NA**	**20.62675**	**3637.25**
Date	**Coll by**	**Project MP**	**FLOW (GPM)**	**Ph**	**Temp (C)**	**AL (UG/L)**	**ALK (MG/L)**	**FE (UG/L)**	**HOT A (MG/L)**	**MN (UG/L)**
9/5/2002	DEP	WB3	4988.00	6.70		1010.00	36.00	4550.00	0.00	4550.00
10/9/2002	DEP	WB3	5365.00	6.50		1210.00	36.00	4330.00	0.00	4330.00
11/5/2002	DEP	WB3	16356.00	6.30		1180.00	30.00	6540.00	43.60	2720.00
12/23/2002	DEP	WB3	32922.00	6.30		1330.00	31.60	5860.00	28.60	2270.00
3/17/2003	DEP	WB3	43352.00	6.20	11.00	1500.00	22.00	1680.00	32.00	1680.00
4/21/2003	DEP	WB3	29845.00	6.50	13.60	860.00	51.40	6220.00	0.00	2370.00
5/20/2003	DEP	WB3	19492.00	6.40	15.90	751.00	66.20	8660.00	2.00	2990.00
6/27/2003	DEP	WB3	49692.00	6.20	17.60	967.00	44.80	5700.00	10.00	2100.00

average			**25251.50**	**6.39**	**14.53**	**1101.00**	**39.75**	**5442.50**	**14.53**	**2876.25**
st dev			**16575.74**	**0.172689**	**2.8652**	**249.7376**	**13.9668**	**2021.052**	**17.5626**	**1042.63**
Date	**Coll by**	**Project MP**	**FLOW (GPM)**	**Ph**	**Temp (C)**	**AL (UG/L)**	**ALK (MG/L)**	**FE (UG/L)**	**HOT A (MG/L)**	**MN (UG/L)**

9/5/2002	DEP	WB4	5261.00	6.90		921.00	56.00	4170.00	0.00	4170.00
10/9/2002	DEP	WB4	7742.00	6.70		1060.00	48.00	3640.00	0.00	3640.00
11/5/2002	DEP	WB4	19916.00	6.40		957.00	40.00	4230.00	27.40	2110.00
12/23/2002	DEP	WB4	37453.00	6.60		1300.00	40.40	4470.00	0.00	1920.00
3/17/2003	DEP	WB4	55077.00	6.50	12.60	1690.00	28.80	5660.00	0.00	1600.00
4/21/2003	DEP	WB4	34057.00	6.70	13.50	881.00	56.20	4760.00	0.00	2200.00
5/20/2003	DEP	WB4	17550.00	6.60	15.30	681.00	64.80	5440.00	0.00	2660.00
6/27/2003	DEP	WB4	60636.00	6.40	17.50	1000.00	49.00	4660.00	2.80	2000.00
average			**29711.50**	**6.60**	**14.73**	**1061.25**	**47.90**	**4628.75**	**3.78**	**2537.50**
st dev			**20711.93**	**0.169031**	**2.1639**	**307.9192**	**11.36913**	**666.7713**	**9.596093**	**905.645**
Date	**Coll by**	**Project MP**	**FLOW (GPM)**	**Ph**	**Temp (C)**	**AL (UG/L)**	**ALK (MG/L)**	**FE (UG/L)**	**HOT A (MG/L)**	**MN (UG/L)**
9/5/2002	DEP	WB5	2179.00	7.40		ND	42.00	167.00	0.00	167.00
10/9/2002	DEP	WB5	2949.00	7.20		ND	46.00	433.00	0.00	433.00
11/5/2002	DEP	WB5	7314.00	6.60		ND	36.00	ND	0.00	586.00
12/23/2002	DEP	WB5	14780.00	6.90		ND	26.80	813.00	0.00	519.00
3/17/2003	DEP	WB5	32074.00	6.70	8.70	710.00	20.00	2590.00	0.00	521.00
4/21/2003	DEP	WB5	13184.00	6.90	12.00	ND	32.60	728.00	0.00	809.00
5/20/2003	DEP	WB5	5276.00	6.70	14.50	ND	35.60	348.00	0.00	806.00
6/27/2003	DEP	WB5	22173.00	6.70	17.60	ND	29.80	869.00	0.00	738.00
average			**12491.13**	**6.89**	**13.20**	**NA**	**33.60**	**849.71**	**0.00**	**572.38**
st dev			**10414.27**	**0.279987**	**3.7745**	**NA**	**8.286995**	**809.9995**	**0**	**216.278**
Date	**Coll by**	**Project MP**	**FLOW (GPM)**	**Ph**	**Temp (C)**	**AL (UG/L)**	**ALK (MG/L)**	**FE (UG/L)**	**HOT A (MG/L)**	**MN (UG/L)**
9/5/2002	DEP	WB6	8764.00	7.50		<500	42.00	1230.00	0.00	1230.00
10/9/2002	DEP	WB6	10528.00	7.10		<500	42.00	1910.00	0.00	1910.00
11/5/2002	DEP	WB6	32795.00	6.60		<500	38.00	1560.00	0.00	1560.00
12/23/2002	DEP	WB6	81000.00	7.00		830.00	34.00	1270.00	0.00	1270.00
3/17/2003	DEP	WB6	119650.00	6.80	13.30	1410.00	23.80	5120.00	0.00	978.00
4/21/2003	DEP	WB6	65595.00	7.00	13.20	609.00	40.60	2390.00	0.00	1590.00
5/20/2003	DEP	WB6	35021.00	7.00	16.40	<500	47.60	2100.00	0.00	1760.00
6/27/2003	DEP	WB6	120000.00	6.70	17.50	738.00	37.20	2350.00	0.00	1290.00
average			**59169.13**	**6.96**	**15.10**	**896.75**	**38.15**	**2241.25**	**0.00**	**1448.50**
st dev			**44819.59**	**0.277424**	**2.1833**	**353.9693**	**7.061161**	**1246.761**	**0**	**309.046**

Permittee: R.S. & W Coal Company
SMP No. 54851332
NPDES No. PA0595756

The samples were collected from a secondary treatment pond (001), N40 deg 39 min 51 sec W76 deg 14 min 6 sec

The source is a gravity flow discharge from an active mine opening est. flow @ 40 gpm. The pond is designed to treat 100 gpm.

Attachment F
Comment and Response

Comments/Responses on West Branch Schuylkill River TMDL

EPA Region III

Comment:

Page 1, *Introduction* section states that this TMDL Report covers two segments on the 1996 Section 303(d) list of impaired waters. The 1996 listed segment was 9 miles long and on the 2002 list, the entire West Branch was included. Therefore, one segment on the 1996 list and one segment on the 2002 list are covered. Please Correct.

Response:

This has been corrected.

Comment:

Is the Oak Hill Tunnel the same as the Pine Knot discharge? Page 18 identifies sample point WB1 as Pine Knot Tunnel while Page 24 identifies WB1 as Oak Hill Tunnel. In addition, the description of WB1 is unclear, does the point represent tunnel discharge only or is it located such that rainfall runoff from the tunnel to the watershed divide is also captured? Please clarify.

Response:

The Oak Hill and Pine Knot are the same tunnel discharge. It will be referred to as the "Oak Hill/Pine Knot Tunnel". "WB1 is below the mouth of the tunnel but is within a constructed lined channel that is solely fed by the tunnel discharge", has been added to the sample point description in Attachment C.

Comment:

WLAs were calculated for RS&W Coal Co. but not for the NPDES permit for Direnzo Coal Co. and, therefore, the WLAs for Direnzo Coal Co. are zero. It is assumed that WLAs are zero because if the pre-existing loads are increased, the permittee is required to treat the discharge back to the pre-existing loads and the pre-existing loads are part of the watershed's LA. If this is correct, the explanation should be added to the TMDL Report.

Response:

An explanation for Direnzo Coal Co. has been added to the TMDL Report in the "Segments addressed in this TMDL" section.